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(54) IMPROVED THERMALLY INSUL ATing MATERIAL

(71) We, MONSANTO CHEMICALS LIMITED, a British Company, of Monsanto House, 10—18 Victoria Street, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved thermally-insulating material of laminated construction. In particular, but not exclusively, the invention relates to an improved laminated, flexible material for thermally-insulating the roofs of buildings.

In the construction of roofs it has been common practice for many years to fix roofing felt to the outwardly-facing surfaces of the roof rafters and then to nail the tile-supporting battens to the rafters with the roofing felt interposed between the rafters and the battens. The roofing felt improves the water-proofness of the roof, prevents dirt from entering the loft through the roof and provides a small degree of thermal insulation for the roof space. The roofing felt used for this purpose is usually a bituminised material, e.g. a hessian based bituminised felt.

In order to improve the thermal insulating properties of the known roofing felt, it has been proposed to employ a laminated roofing felt consisting of the known bituminised roofing material laminated to a layer of glass wool. In use the bituminised felt faces outwardly and the glass wool layer faces inwardly. This material has two main disadvantages. In the first place water vapour in the atmosphere condenses in the glass wool and considerably decreases its thermal insulation effect. In the second place the glass wool layer cannot be compressed to a very small thickness. Consequently, when two sheets of material have to be overlapped, a distinct ridge is produced in the region of overlap unless the glass wool layer is removed from one sheet in the region of overlap during laying of the material, or unless provision is made at the time of manufacturing the material to omit a strip of the glass wool layer along one edge of the material.

An object of the present invention is to provide a thermally-insulating material of laminated construction which does not have the disadvantages referred to above.

According to the invention thermally-insulating material comprises a single layer of resilient, foamed thermoplastics material sandwiched between a flexible aluminium, aluminium alloy or aluminised film on one side and a layer of flexible non-metallic, water-impervious material on the other side.

The foamed thermoplastics material is preferably of the closed cell type and may be, for example, polyethylene or polystyrene foam. The main purpose of this central layer is to provide the major thermal insulating effect of the laminated material and the thickness of the layer in any particular laminated material is determined by the intended use of the material.

The purposes of the aluminium, aluminium alloy or aluminised film are to provide the laminated material with a good heat-reflecting surface and to provide a vapour barrier covering for the foamed thermoplastics layer. The requirements for the aluminium, aluminium alloy or aluminised film are that it should be strong enough to resist being torn during normal handling of the material, that it should be sufficiently flexible to allow shaping of the material around objects to be thermally-insulated, and that it should be cheap. A very suitable material is a foil of aluminium or aluminium alloy having a thickness of from 0.00035 to 0.005 inch, preferably about 0.0005 inch. Another suitable material is aluminised

[*Price 5s. 0d. (25p)*]

polyester film having a thickness of from 0.00035 to 0.002 inch.

The layer of flexible non-metallic, water-impervious material may be a woven or non-woven fabric, felt or paper impregnated with bitumen. A particularly suitable material for this layer is hessian-based bituminised roofing felt in accordance with B.S. 747. The hessian may have a very coarse weave, for example 4 to 5 warps and wefts to the inch. Other suitable materials for this non-metallic water-impervious layer are Kraft paper or felts of sisal fibres impregnated with bitumen, or a sheet of plastics material, for example polyvinyl chloride sheet having a thickness of from 0.0005 to 0.005 inch. The main purpose of the non-metallic, water-impervious layer is to provide the laminated material with a strong water-proof layer.

The laminated material according to the invention may be made by adhering the three layers together. When the flexible non-metallic, water-impervious material is a bituminised material, the foamed thermoplastics layer may be heat-bonded thereto during manufacture of the bituminised material, and the aluminium, aluminium alloy or aluminised film may be adhered to the foamed layer with any suitable adhesive, for example bitumen or a latex-based adhesive, which does not damage the foamed material. Alternatively, the foamed thermoplastics layer may be bonded to both of the other layers of the laminated material with an adhesive.

Alternatively the laminated material may be made by foaming the thermoplastic material *in situ* between the aluminium, aluminium alloy or aluminised film and the layer of flexible non-metallic, water impervious material. In this case the employment of an adhesive between the central layer and the aluminium, aluminium alloy or aluminised film is not required.

When laminated material in accordance with the invention is employed in place of conventional roofing felt in the process described above for lining a roof, the laminated material is fixed to the roof rafters with the flexible non-metallic, water-impervious layer facing outwardly and the layer of aluminium, aluminium alloy or aluminised film facing inwardly. Since the resilient foamed thermoplastics material is highly compressible, two sheets of the material can be overlapped and compressed in the region of overlap to the thickness of one sheet. The lined roof can therefore have a substantially smooth outwardly-facing surface without the need for removing part of the material in the region of overlap. The aluminium, aluminium alloy or aluminised film provides a vapour barrier which prevents moisture in the roof space entering the central foamed thermoplastics layer, at the same time providing a good heat-reflecting surface.

The invention will now be further described with reference to the following non-limitative Examples.

Example 1

A thermally-insulating material was made by heat-bonding a layer of foamed closed cell-type, polystyrene having a thickness of ¼ inch to one side of a sheet of hessian-based bituminised roofing felt in accordance with B.S. 747. A sheet of aluminium foil having a thickness of 0.0008 inch was adhered to the other side of the foamed polystyrene layer using bitumen as the adhesive. It was found that this insulating material more than adequately fulfilled the requirements of Regulation F 3 of the Building Regulations 1965 concerning the thermal insulation of buildings, providing U-values of from 0.23 to 0.24.

Example 2

A thermally-insulating material was made in the same way as described in Example 1, except that for the sheet of aluminium foil there was substituted aluminised polyester film having a thickness of 0.0005 inch which was adhered to the foamed polystyrene layer using a latex-based adhesive. This insulating material had substantially the same thermal insulation properties as the material described in Example 1.

Example 3

A thermally-insulating material was made in the same way as described in Example 1, except that for the sheet of hessian-based bituminised roofing felt there was substituted black polyvinyl chloride sheet having a thickness of 0.001 inch, which was adhered to the foamed polystyrene layer using a latex-based adhesive. This insulating material had substantially the same thermal insulation properties as the material described in Example 1.

Example 4

A thermally-insulating material was made in the same way as described in Example 3, except that for the sheet of aluminium foil there was substituted aluminised polyester film having a thickness of 0.0005 inch which was adhered to the foamed polystyrene layer using a latex-based adhesive. This insulating material had substantially the same thermal insulation properties as the material described in Example 1.

By increasing the thickness of the polystyrene layer to ½ inch in each of the above described materials it is possible to achieve U-values of from 0.18 to 0.19.

Although the above description empha-

sises the use of the laminated material according to the invention as a roof insulating material, it will be appreciated that the material may be employed for other thermal insulation purposes.

WHAT WE CLAIM IS:—

1. A thermally-insulating material comprising a single layer of resilient, foamed thermoplastics material sandwiched between a flexible aluminium, aluminium alloy or aluminised film on one side and a layer of flexible non-metallic, water-impervious material on the other side.

2. A thermally-insulating material as claimed in claim 1, in which the layer of flexible non-metallic, water-impervious material is polyvinyl chloride sheet.

3. A thermally-insulating material as claimed in claim 2, in which said polyvinyl chloride sheet has a thickness of from 0.0005 to 0.005 inch.

4. A thermally-insulating material as claimed in claim 1, in which said layer of flexible non-metallic, water-impervious material is bituminised material.

5. A thermally-insulating material as claimed in claim 4, in which said layer of flexible non-metallic, water-impervious material is felt, paper or woven or non-woven fabric impregnated with bitumen.

6. A thermally-insulating material as claimed in claim 5, in which said layer of flexible non-metallic, water-impervious material is a hessian-based bituminised felt material.

7. A thermally-insulating material as claimed in any of claims 1 to 6, in which said aluminised film is an aluminised polyester film.

8. A thermally-insulating material as claimed in claim 7, in which said aluminised polyester film has a thickness of from 0.00035 to 0.002 inch.

9. A thermally-insulating material as claimed in any of claims 1 to 6, in which said aluminium or aluminium alloy film has a thickness of from 0.00035 to 0.005 inch.

10. A thermally-insulating material as claimed in any of the preceding claims, in which said foamed thermoplastic material is of the closed cell type.

11. A thermally-insulating material as claimed in any of the preceding claims, in which said foamed plastics material is polyethylene or polystyrene.

12. A thermally-insulating material as claimed in any of the preceding claims, in which said foamed thermoplastics material is bonded to the aluminium, aluminium alloy or aluminised film and to the layer of non-metallic, water-impervious material with an adhesive.

13. A thermally-insulating material as described in any of the foregoing Examples.

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